



April 1988  
Revised July 1999

# 74F138

## 1-of-8 Decoder/Demultiplexer

### General Description

The F138 is a high-speed 1-of-8 decoder/demultiplexer. This device is ideally suited for high-speed bipolar memory chip select address decoding. The multiple input enables allow parallel expansion to a 1-of-24 decoder using just three F138 devices or a 1-of-32 decoder using four F138 devices and one inverter.

### Features

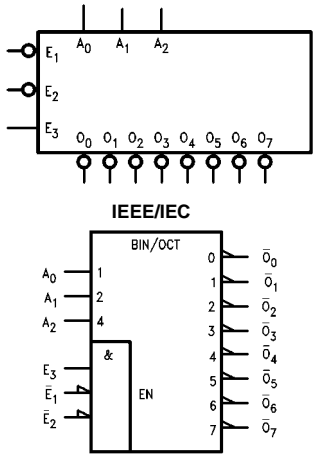
- Demultiplexing capability
- Multiple input enable for easy expansion
- Active LOW mutually exclusive outputs

### Ordering Code:

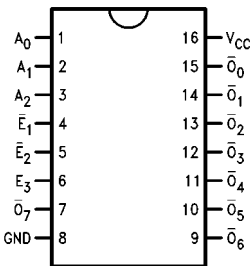
Order Number	Package Number	Package Description
74F138SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
74F138SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74F138PC	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide

Devices also available in Tape and Reel. Specify by appending the suffix letter "X" to the ordering code.

### Logic Symbols



### Connection Diagram



74F138 1-of-8 Decoder/Demultiplexer

### Unit Loading/Fan Out

Pin Names	Description	U.L. HIGH/LOW	Input $I_{IH}/I_{IL}$ Output $I_{OH}/I_{OL}$
$A_0$ – $A_2$	Address Inputs	1.0/1.0	20 $\mu$ A/–0.6 mA
$\bar{E}_1, \bar{E}_2$	Enable Inputs (Active LOW)	1.0/1.0	20 $\mu$ A/–0.6 mA
$E_3$	Enable Input (Active HIGH)	1.0/1.0	20 $\mu$ A/–0.6 mA
$\bar{O}_0$ – $\bar{O}_7$	Outputs (Active LOW)	50/33.3	–1 mA/20 mA

### Truth Table

Inputs						Outputs							
$\bar{E}_1$	$\bar{E}_2$	$E_3$	$A_0$	$A_1$	$A_2$	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

H = HIGH Voltage Level  
L = LOW Voltage Level  
X = Immaterial

### Functional Description

The F138 high-speed 1-of-8 decoder/demultiplexer accepts three binary weighted inputs ( $A_0, A_1, A_2$ ) and, when enabled, provides eight mutually exclusive active LOW outputs ( $\bar{O}_0$ – $\bar{O}_7$ ). The F138 features three Enable inputs, two active LOW ( $\bar{E}_1, \bar{E}_2$ ) and one active HIGH ( $E_3$ ). All outputs will be HIGH unless  $\bar{E}_1$  and  $\bar{E}_2$  are LOW and  $E_3$  is HIGH. This multiple enable function allows easy parallel

expansion of the device to a 1-of-32 (5 lines to 32 lines) decoder with just four F138 devices and one inverter (See Figure 1). The F138 can be used as an 8-output demultiplexer by using one of the active LOW Enable inputs as the data input and the other Enable inputs as strobes. The Enable inputs which are not used must be permanently tied to their appropriate active HIGH or active LOW state.

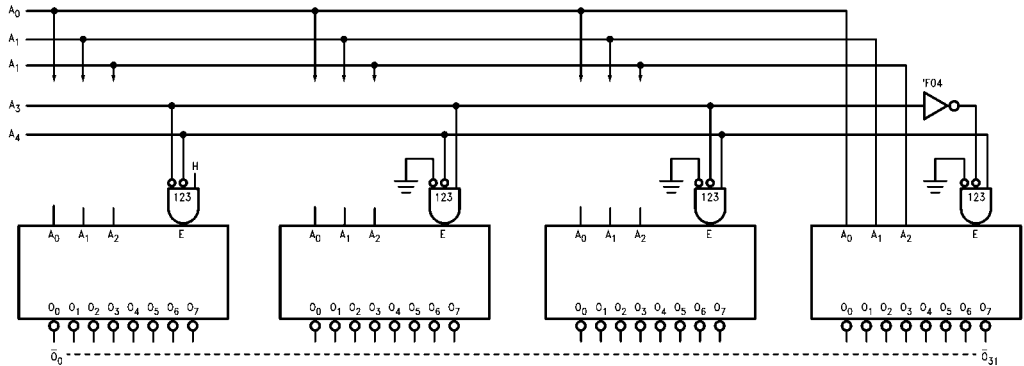
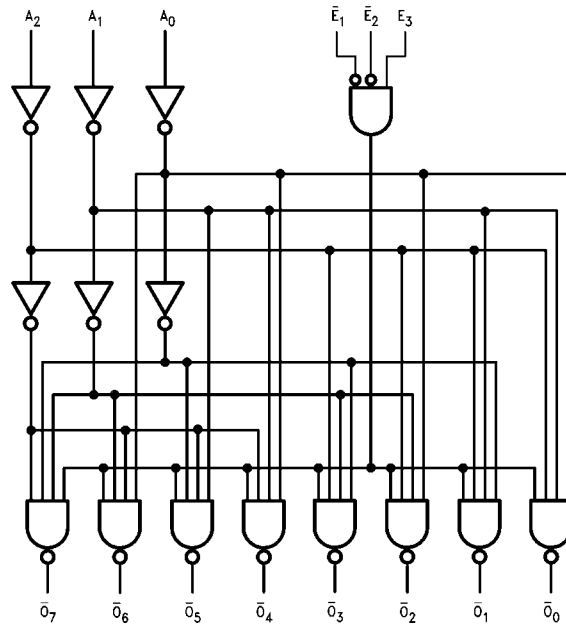


FIGURE 1. Expansion to 1-of-32 Decoding

## Logic Diagram



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

**Absolute Maximum Ratings**(Note 1)

Storage Temperature	−65°C to +150°C
Ambient Temperature under Bias	−55°C to +125°C
Junction Temperature under Bias	−55°C to +150°C
V <sub>CC</sub> Pin Potential to Ground Pin	−0.5V to +7.0V
Input Voltage (Note 2)	−0.5V to +7.0V
Input Current (Note 2)	−30 mA to +5.0 mA
Voltage Applied to Output in HIGH State (with V <sub>CC</sub> = 0V)	
Standard Output	−0.5V to V <sub>CC</sub>
3-STATE Output	−0.5V to +5.5V
Current Applied to Output in LOW State (Max)	twice the rated I <sub>OL</sub> (mA)
ESD Last Passing Voltage (Min)	4000V

**Recommended Operating Conditions**

Free Air Ambient Temperature	0°C to +70°C
Supply Voltage	+4.5V to +5.5V

**Note 1:** Absolute maximum ratings are values beyond which the device may be damaged or have its useful life impaired. Functional operation under these conditions is not implied.

**Note 2:** Either voltage limit or current limit is sufficient to protect inputs.

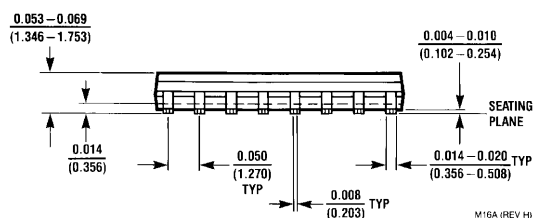
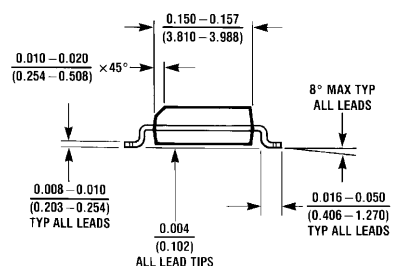
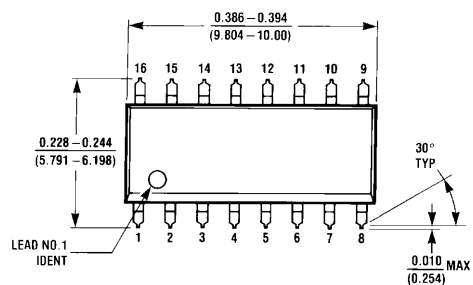
**DC Electrical Characteristics**

Symbol	Parameter	Min	Typ	Max	Units	V <sub>CC</sub>	Conditions
V <sub>IH</sub>	Input HIGH Voltage	2.0			V		Recognized as a HIGH Signal
V <sub>IL</sub>	Input LOW Voltage			0.8	V		Recognized as a LOW Signal
V <sub>CD</sub>	Input Clamp Diode Voltage			−1.2	V	Min	I <sub>IN</sub> = −18 mA
V <sub>OH</sub>	Output HIGH Voltage	10% V <sub>CC</sub> 5% V <sub>CC</sub>	2.5 2.7		V	Min	I <sub>OH</sub> = −1 mA I <sub>OH</sub> = −1 mA
V <sub>OL</sub>	Output LOW Voltage	10% V <sub>CC</sub>		0.5	V	Min	I <sub>OL</sub> = 20 mA
I <sub>IH</sub>	Input HIGH Current			5.0	μA	Max	V <sub>IN</sub> = 2.7V
I <sub>BVI</sub>	Input HIGH Current Breakdown Test			7.0	μA	Max	V <sub>IN</sub> = 7.0V
I <sub>CEX</sub>	Output HIGH Leakage Current			50	μA	Max	V <sub>OUT</sub> = V <sub>CC</sub>
V <sub>ID</sub>	Input Leakage Test	4.75			V	0.0	I <sub>ID</sub> = 1.9 μA All Other Pins Grounded
I <sub>OD</sub>	Output Leakage Circuit Current			3.75	μA	0.0	V <sub>IOD</sub> = 150 mV All Other Pins Grounded
I <sub>IL</sub>	Input LOW Current			−0.6	mA	Max	V <sub>IN</sub> = 0.5V
I <sub>OS</sub>	Output Short-Circuit Current	−60		−150	mA	Max	V <sub>OUT</sub> = 0V
I <sub>CCH</sub>	Power Supply Current		13	20	mA	Max	V <sub>O</sub> = HIGH
I <sub>CCL</sub>	Power Supply Current		13	20	mA	Max	V <sub>O</sub> = LOW

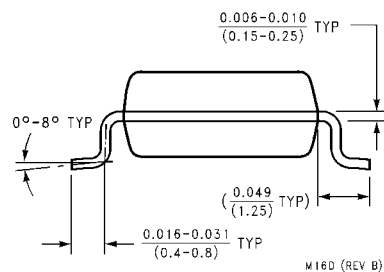
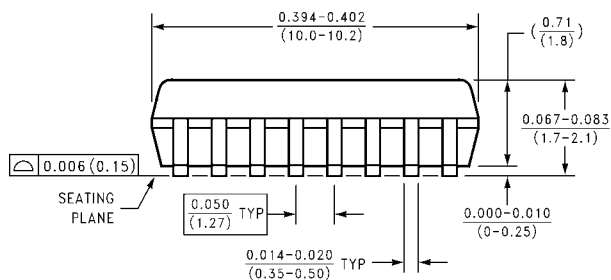
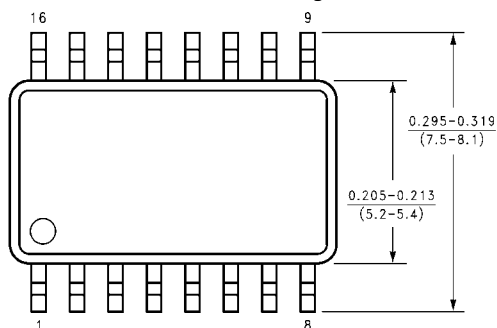
**AC Electrical Characteristics**

Symbol	Parameter	T <sub>A</sub> = +25°C V <sub>CC</sub> = +5.0V C <sub>L</sub> = 50 pF			T <sub>A</sub> = 0°C to +70°C V <sub>CC</sub> = +5.0V C <sub>L</sub> = 50 pF		Units
		Min	Typ	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay A <sub>n</sub> to $\overline{O}_n$	3.5	5.6	7.5	3.5	8.5	ns
t <sub>PHL</sub>		4.0	6.1	8.0	4.0	9.0	
t <sub>PLH</sub>	Propagation Delay $\overline{E}_1$ or $\overline{E}_2$ to $\overline{O}_n$	3.5	5.4	7.0	3.5	8.0	ns
t <sub>PHL</sub>		3.0	5.3	7.0	3.0	7.5	
t <sub>PLH</sub>	Propagation Delay E <sub>3</sub> to $\overline{O}_n$	4.0	6.2	8.0	4.0	9.0	ns
t <sub>PHL</sub>		3.5	5.6	7.5	3.5	8.5	

# Physical Dimensions inches (millimeters) unless otherwise noted

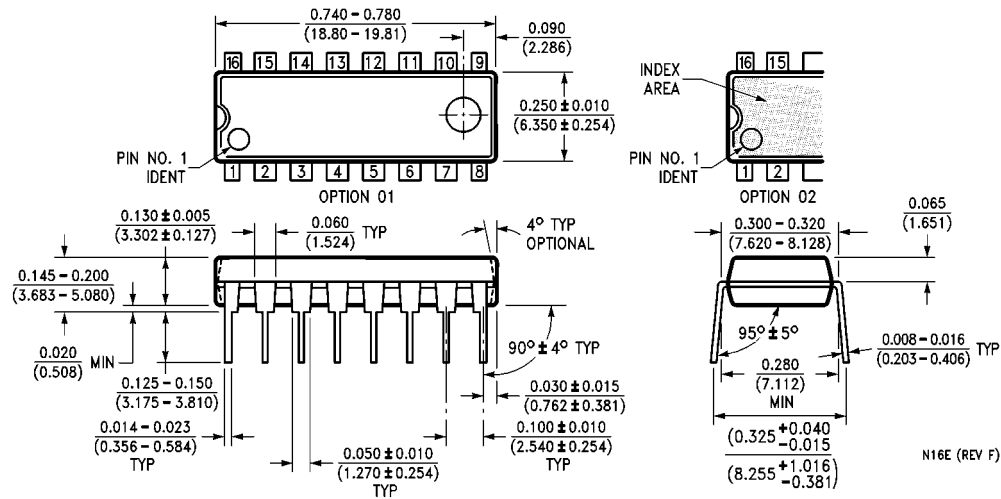


**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow  
Package Number M16A**



**16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide  
Package Number M16D**

## Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



N16E (REV F)

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